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Constraints related to agropastoral practices in the face of the challenges of climate change in the municipality of Grand-Popo in Benin

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ABSTRACT: In many regions of the world, and specifically in the municipality of Grand-Popo in Benin, agropastoral practices are essential for the local economy and the livelihoods of communities. However, these activities are increasingly threatened by the impacts of climate change. Variations in precipitation, prolonged droughts, sudden floods, and other extreme weather phenomena disrupt the natural cycles of crop growth, as well as the availability of pasturelands. Additionally, overexploitation of natural resources leads to soil degradation and damage to fragile ecosystems.
This research aims to analyze the constraints faced by agropastoralists in the municipality of Grand-Popo.
To this end, qualitative and quantitative data were collected using interview guides and questionnaires from a random sample of 120 individuals, including farmers, herders, and agropastoralists. The data were analyzed using descriptive statistics.
The results indicate that agropastoralists are facing several constraints. These include health issues, conflicts related to space management, mainly due to animal wandering, overgrazing, and destructive farming practices leading to the disappearance of certain species. Additionally, droughts have a significant impact, with a lack of water infrastructure in the municipality and limited water resources in grazing areas. Floods also result in significant losses, with a high concentration of herds in certain areas of the municipality, causing damage to crops and the death of many animals.

KEYWORDS: Grand-Popo municipality, agropastoralism, constraints, practices, climate change.

1 INTRODUCTION

Rural activities, particularly agriculture and livestock farming, are the main sources of human food products worldwide (Chaffa, 2009). Indeed, their contribution to economic development is very significant. In Africa, the implementation of these activities is based on the exploitation of natural resources (soil, vegetation, watercourses, and water bodies...) with rudimentary practices (Sogbohossou, 2000).

In sub-Saharan Africa, agricultural and pastoral activities are the main concerns of the populations benefiting from them. As a result, competitions and even conflicts arise over access to cultivable land (Houinato, 2001).

Also, faced with difficulties in accessing land and inputs, the elimination of fallow periods or the reduction of their duration, the use of organic fertilizers remains an alternative. This is why organic fertilization, whose application provides nutrients to plants while improving soil structure, is increasingly promoted (Ullah et al, 2008).

In Benin, agriculture forms the backbone of the economy and constitutes the primary source of employment for the active population, providing 70% of jobs (MCPD, 2018). Livestock farming is the second agricultural activity in the country after crop production. The livestock includes various domestic animal species (cattle, sheep, goats, pigs, poultry...) as well as non-conventional species such as the grasscutter (MAEP, 2017).

In Benin, the economy relies on the rural sector, with agriculture and livestock contributing 38% and 25% respectively to the agricultural GDP (FAO, 2011).

In integrated agriculture and livestock management, agriculture and livestock interact to create synergies, optimizing resource utilization: waste from one component serves as resources for the other. Thus, livestock manure improves agricultural production, while crop residues and by-products serve as feed supplements for animals (FAO, 2011).

Livestock farming in general, and cattle farming in particular, produces valuable nutrients in the form of livestock effluents and dung used for soil amendment, as well as raw materials for biogas production (Copa-Cogeca, 2011).

Farmers, herders, and agropastoralists face enormous challenges related to their livelihood activities in the municipality of Grand-Popo. The objective of this research is to analyze the constraints related to agropastoral practices in the face of the challenges of climate change.

The research area is located between 9°00’ and 37°00’ East longitude and 7°00’ and 51°00’ North latitude, covering an area of 289 km2, representing 7.2% of the entire Mono department with an average population density of about 230 inhabitants/km2 (Figure 1).

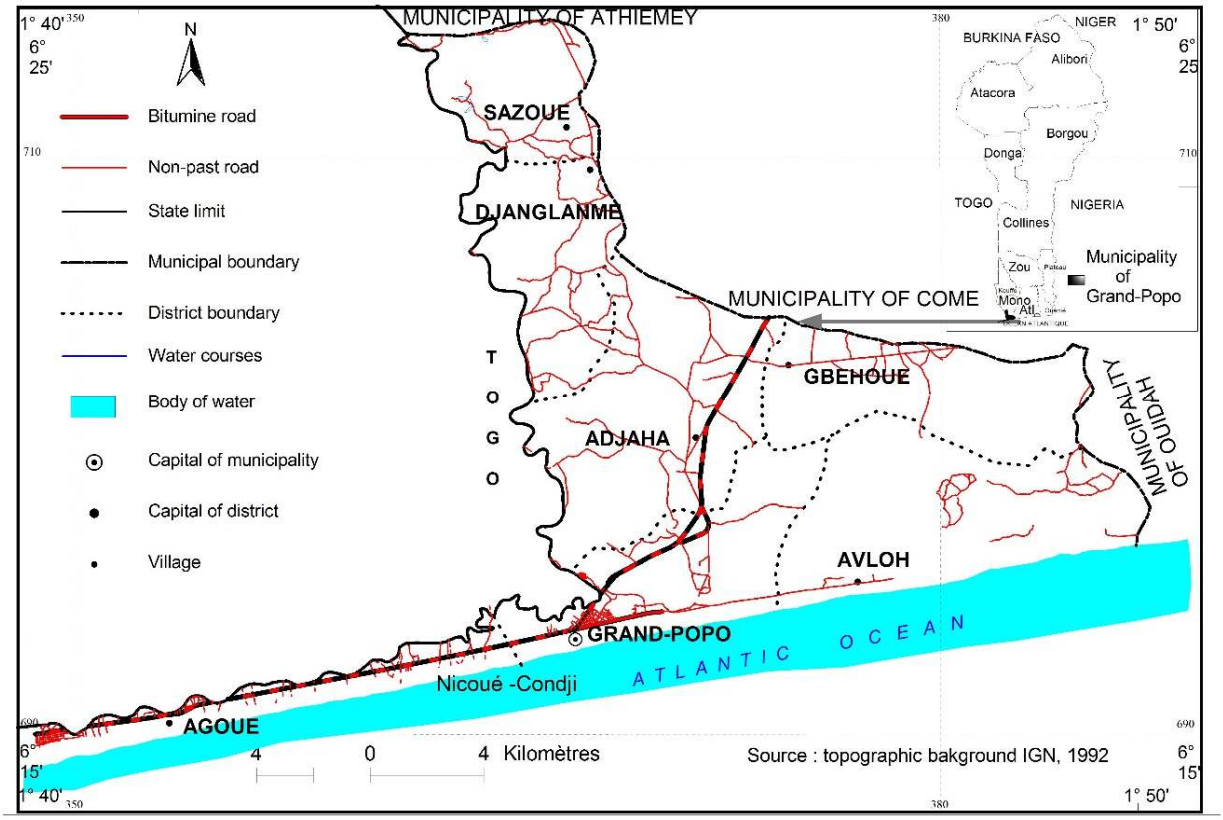

Fig. 1. Geographic location of the research area

2 RESEARCH METHODOLOGY

2.1 SAMPLING

Sampling is defined randomly by district taking into account the extent of agropastoral activities. The statistical unit is the household engaged in agricultural activities (farming, livestock rearing, or both) for at least 10 years. These 10 years have been chosen for reasons such as the youthfulness of the population, reasons for good memory, and a thorough understanding of the techniques and constraints related to agropastoral activities.

To this end, the sample size was determined using the formula:

Y = E * X (Gounou, 2014)

Where

Y: sample size;
E: number of agropastoral households; and
X: sampling rate set at 2%.

Furthermore, the study focused on 6 districts, namely: Adjaha, Agoué, Djanglanmey, Gbéhoué, Sazoué, and Grand-Popo out of the 7 in the municipality of Grand-Popo. The selection of villages is based on the presence of both farmers and herders in the village, the extent of agropastoral activities, and the more flood-prone areas in the municipality.

Table one shows the number of households surveyed by district in the municipality of Grand-Popo.

Table 1. Number of households surveyed

DISTRICTS	FARMERS	HERDERS	AGROPASTORALISTS	TOTAL
ADJAHA	10	8	0	18
AGOUE	20	0	3	23
DJANGLANMEY	9	16	0	25
GBEHOUE	7	5	3	15
GRAND-POPO	17	0	4	21
SAZUE	8	10	0	18
TOTAL	71	39	10	120

Source: Survey Results, June 2023

The analysis of Table I reveals that the number of households surveyed per district is proportional to the household 6 of each district in the municipality. According to this table, 18 individuals were surveyed in the Adjaha district, including 10 farmers and eight herders; 23 individuals in the Agoué district, including 20 farmers and 3 agropastoralists; 25 individuals in the Djanglanmey district, including nine farmers and 16 herders; 15 individuals in the Gbéhoué district, including seven farmers, 5 herders, and three agropastoralists; 21 individuals in the central district of Grand-Popo, including 17 farmers and four agropastoralists; and finally, 18 individuals in the Sazué district, including 8 farmers and 10 agropastoralists. Thus, a total of 120 individuals engaged in agricultural, pastoral, and/or agropastoral activities were surveyed in 6 districts of the study area (Adjaha, Agoué, Djanglanmey, Gbéhoué, Grand-Popo, and Sazué). Table II presents a summary of the sample size.

Table 2. Summary of the Sample Size

Resource persons surveyed	Veterinarian	Locally competent agents	Agro-breeders	Officials of farmer organizations	Total
Staff	1	3	120	2	126

Source: Survey Results, July 2023.

Beyond the 120 individuals surveyed in the field, resource persons were also surveyed, including 1 veterinarian, 3 locally competent agents (municipal and ATDA agents), and two officials of farmer organizations in the municipality.

In total, 126 individuals were surveyed during our study.

2.2 DATA COLLECTION TECHNIQUES, TOOLS, AND MATERIALS

To gather maximum information and data, certain data collection techniques were adopted. Direct observations in fields and herds of Fulani herders helped analyze agropastoral constraints in the municipality.

Direct observation enabled us to observe the hydrographic network, agropastoral farms, and passages, although they are not defined. Interviews were conducted with agro-breeders, health agents, and farmer organizations.

Several tools and materials are used during data collection in the field. These include:

- a topographic map for the study area location
- mobile phone
- camera for taking photographs
- administrative map of the municipality
- household survey questionnaire
- interview guide for conducting investigations with officials of farmer organizations, agricultural sector agents, and the veterinarian of the municipality of Grand-Popo.
- GPS (Global Positioning System)

2.3 FIELDWORK

Regarding the fieldwork, it allowed us to obtain a database of quantitative and qualitative data related to agropastoral activities from agropastoralists, farmer organizations, and resource persons in our study area. Additionally, it helped identify the difficulties hindering the development of agropastoral activities in the municipality of Grand-Popo.

FIELD SURVEY

The field survey was conducted through periodic visits to the target population. This part was carried out in two phases:

- The first phase, the pre-survey, was conducted as a prelude to the main survey phase. It allowed us to assess the situation to obtain a brief overview of agropastoral systems. It took place in May 2023 through contacting stakeholders and visiting documentation centers.
- The second phase is the actual survey, which systematically collected data to understand the reality on the ground compared to the information gathered from documents. Surveys were conducted among farmers, herders, or those practicing both, and finally, authorities responsible for agriculture (veterinarians, municipal agents, and other relevant services).

2.4 DATA PROCESSING AND ANALYSIS

During this phase, the questionnaires were processed, data were analyzed, and the results obtained during our investigations were analyzed to establish correlations between documentary information and the reality examined in the field. To accomplish this, several software programs were used, including:

- Excel 2013 for processing quantitative data, calculating averages, and creating tables and diagrams relevant to the work.
- Word 2013 for text processing.
- ArcView for creating maps.

Percentages were calculated based on the total number of respondents.

3 RESULTS AND DISCUSSION

3.1 ADVANTAGES OF LANDSCAPE COMPOSITION FOR AGROPASTORALISM

The vegetation exhibits a diverse composition including Elaeis guineensis (oil palm), Borassus aethiopium (ronier palm), Mitragyna inermis, Adansonia digitata (baobab), Ceiba pentandra (kapok tree), and Milicia excelsa (iroko). It is noteworthy that the ronier palm is endangered due to its use in basketry.

In the inland areas of the mangrove, characterized by alluvial and hydromorphic soils, as well as low valley soils and coastal lagoons, the vegetation is mainly herbaceous. Variable densities of species such as mangroves (Avicennia and Rhizophora), rushes, and grasses, among others, are found in the research area (Figure 2).

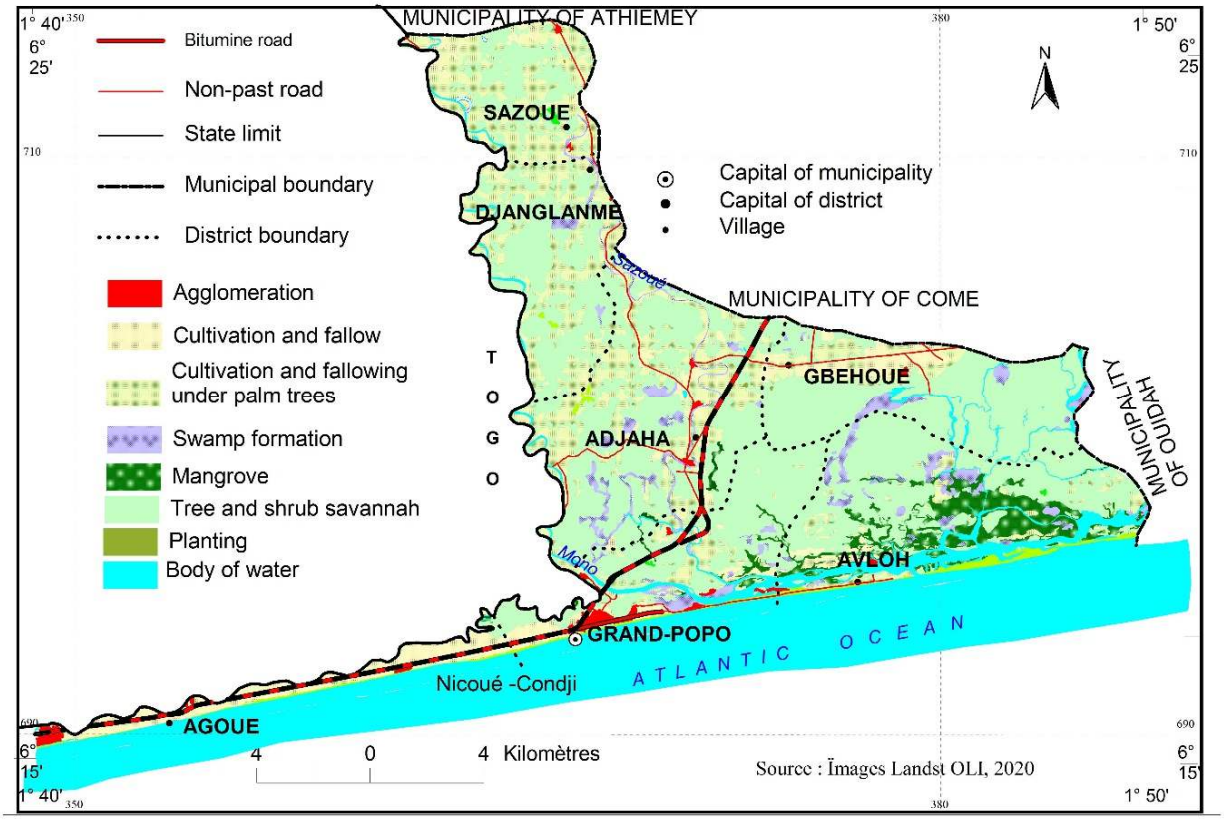

Fig. 2. Vegetation Map of the Municipality of Grand-Popo

Figure 2 reveals a composition dominated by several types of vegetation formations. It is noteworthy primarily for the presence of open forests, gallery forests, marshy forests, forest plantations, savannas, and finally wooded savannas.

Savanna and wooded savanna are the most predominant types of vegetation. These vegetation formations are characteristic of hot regions facing long dry seasons and are mainly composed of herbaceous plants of the Poaceae family (grasses), interspersed with trees and shrubs.

These characteristics allow herders to graze their animals year-round without resorting to transhumance.

3.2 HYDROGRAPHIC NETWORK, A GREAT ASSET FOR AGROPASTORALISTS

The Municipality of Grand-Popo is endowed with a significant hydrographic network, including the Mono River as well as several tributaries and outlets such as the Sazoué (the most important), Agogo, Adanwadonmè, etc. The navigability of these watercourses depends in part on the flow regime of the Mono River.

The municipality also hosts the Grand-Popo lagoon, stretching over a length of 15 km and opening into the Aho channel. This lagoon receives waters from both the ocean and the Mono River, and also communicates with that of Ouidah.

Figure 3 provides detailed information on the hydrographic network of the municipality of Grand-Popo.

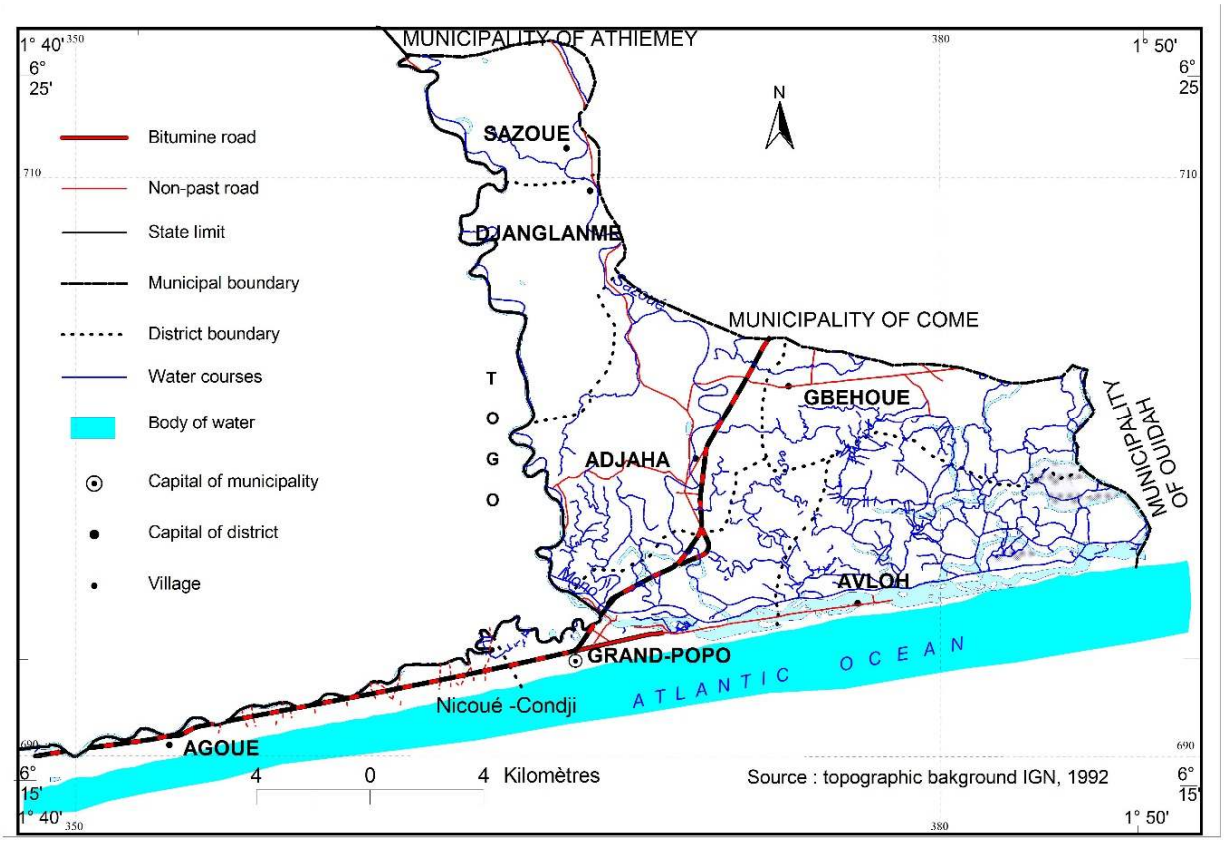

Fig. 3. Hydrographic Network of the Municipality of Grand-Popo in Benin

Analysis of Figure 3 highlights the presence of temporary watercourses such as Hèsssouvé and Démlin, as well as permanent watercourses such as Sazué, crossing the districts of Sazué, Djanglanmey, Adjaha, and Grand-Popo, Doyimé in the Gbéhoué district, and Egbin in the Adjaha district.

The Mono River runs along the entire western part of the municipality, and these various watercourses are conducive not only to agriculture but also to pastoral livestock farming. This extensive hydrographic network promotes off-season agriculture, market gardening, and especially pastoral livestock farming during the dry season, thanks to the presence of permanent watercourses where animals can drink even in times of drought.

It is important to analyze the constraints related to agropastoral practices in the face of the challenges of climate change.

3.3 Search For Forage For Livestock Feeding

The search for forage for livestock feeding in the municipality of Grand-Popo is a vital necessity for herds, and this need remains constant throughout the year, regardless of the season. Grazing mainly takes place on the territories where the herds reside, meaning they do not need to travel long distances to access water, according to 10% of the surveyed individuals.

However, due to the high concentration of herds in the municipality, cases of overgrazing are observed. It is also noteworthy that the practice of transhumance is not common in the research area, meaning that 80% of herds are sedentary.

3.4 Water And Its Importance In The Agropastoral System In The Municipality Of Grand-Popo

In an agropastoral system, water is the primary and indispensable element in production, according to 90% of the surveyed individuals. Water is used by agricultural producers in general and agro-breeders in particular for watering herds. The geographical location of the municipality is favorable to pastoralism due to the presence of the Mono River and watercourses, as well as rainfall; this facilitates access to watering herds throughout the year.

3.5 PATHOLOGICAL CONSTRAINTS

The increasing prevalence of animal diseases in the sub-region, and more specifically in Benin, represents a major challenge for Fulani herders in general, and those in the municipality of Grand-Popo in particular. Animals, in search of pasture, are exposed to various diseases, often through direct contact in the same grazing or resting areas, as well as through the humid and cool conditions characteristic of the rainy season. Furthermore, contact with new cattle purchased at markets is another vector of disease transmission, according to 80% of the surveyed individuals. Table three provides an overview of the different common pathologies in the municipality.

Table 3. Different Pathologies with Their Symptoms

Pathologies	Local name	Symptoms
Pasteurellosis	HEENYERE	-tearing and depression -breathing difficulties - incessant coughing
Scabies	N'YANYAANRE	-the animal scratches -hairs fall out -appearance of scabs and pimples
Coccidiosis	TCHARI BODEEDJI	-diarrhea with red blood
Foot-and-mouth disease	THAABOU	-mouth ulcers and salivation in the mouth -fever, abortion, lack of milk in the udder and many cattle die

Source: Field Surveys, June 2023.

According to Table three, the most common diseases reported by the respondents are Pasteurellosis, Scabies, Coccidiosis, and Foot-and-mouth disease. These diseases result from various factors, including animal contact in grazing areas, moisture present in these areas during the rainy season, irregularity in cattle vaccination campaigns, and contact of newly purchased animals in local markets (such as the livestock markets of Comé, Bohicon, and occasionally Zè) with sedentary animals without prior quarantine.

According to information gathered from the interviewed veterinarian, two vaccination campaigns are organized each year against the main deadly diseases of cattle, namely Contagious Bovine Pleuropneumonia (CBPP) and Pest. Before the start of these campaigns, the veterinarian holds awareness sessions with the farmers, in collaboration with farmer organizations such as the Association for the Promotion of Livestock in the Sahel and Savannah (APESS) and the Communal Union of Professional Livestock Organizations of Ruminants (UCOPER). Subsequently, vaccination of the herds is carried out. For other diseases, farmers do not consult veterinarians but treat the animals themselves using veterinary products and traditional practices.

3.6 CONSTRAINTS RELATED TO CONFLICT MANAGEMENT AND SPACE

Managing the agropastoral system is a major concern in the Republic of Benin, particularly in the commune of Grand-Popo, due to its potential. Since agriculture and pastoralism coexist in the same space, several conflicts emerge. In this context, conflict often results from divergences between farmers, herders, and other actors directly or indirectly involved in the agropastoral system.

Field investigations have identified two main sources of conflicts: conflicts related to animal trespassing in fields and conflicts related to land management. Among these two types of conflicts, animal trespassing-related conflicts are more common in the commune of Grand-Popo, involving 60% of farmers and herders. Moreover, conflicts related to land management pose major constraints on the practice of agropastoral activities. The absence of passage corridors and the anarchic establishment of agricultural farms on cattle passage routes are significant obstacles for herders, often leading to conflicts with farmers.

It is also important to note that misunderstanding of the regulations governing pastoralism in the Republic of Benin is another factor contributing to conflicts. Figure 4 illustrates a herd of cattle trespassing in a field, thus illustrating one of the conflict situations encountered in the region.

Fig. 4. Herd of cattle trespassing in a field in Adjaha

Photographer: Soumanou, June 2023

Figure 4 depicts a herd of cattle grazing in a maize field that has not yet been harvested. This situation constitutes the main source of conflict between farmers and herders in the commune. It is worth noting that when a herd owner is identified, they may choose to settle the dispute amicably by offering financial compensation based on the size and area of the damaged field, which represents 60% of cases. In the remaining 40%, if the owner refuses to acknowledge responsibility or offers compensation lower than that demanded by the farmer, the dispute may be brought before the appropriate authorities, such as the police station.

3.7 CONSTRAINTS RELATED TO OVERGRAZING AND FARMING PRACTICES

Overgrazing is a form of pasture degradation resulting from an excessive number of domestic animals. Mainly associated with extensive pastoralism, it leads to a reduction or disappearance of vegetation cover, compaction of the topsoil layer, and the formation of rills and erosive gullies, thus causing physical soil degradation. This phenomenon results in the total disappearance of certain plant species, while the emergence of new species, often not favored by animals, becomes a source of food scarcity for them during the dry season.

On the other hand, in agriculture, deforestation represents one of the main environmental aggressions. It contributes to the exposure of the soil, which conditions the initiation of various soil degradation processes and consequently leads to the disappearance of certain plant species. Indeed, the cultivation of rice, as well as the cultivation of banana trees, oil palms, and coconut trees, leads to massive vegetation destruction.

3.8 CONSTRAINTS RELATED TO DROUGHT IN THE COMMUNE OF GRAND-POPO

In the commune of Grand-Popo, the dry season extends from November to March and is characterized by minimal rainfall, excessive temperatures, and the onset of harmattan, a dry, cold, and harsh wind. Every year since 2017, the waters of the Mono River rise, causing floods, except in 2020 when no flooding was recorded. After the waters recede, they stagnate in ponds and watercourses until February or March, reducing the impact of drought on agro-pastoralists. In the districts of Adjaha, Djanglanmey, and Sazué, farmers take advantage of this period to cultivate off-season crops such as crincrin, "gboma," and okra.

In the Gbéhoué district, for example, a non-floodable area, pastoralists cope with the effects of drought by using two water reservoirs to water their animals: an old sand dredging site where water remains permanently, and a direct pumping point. During the dry season of 2020, most pastoralists in Hanmlangny, a locality in Djanglanmey, had to travel more than 4 km to water their animals in Kpovidji, a locality in Adjaha with a permanent water source.

In the central part of the Grand-Popo district, farmers face the effects of drought by practicing irrigation for crops such as onions, tomatoes, lettuce, vegetables, and carrots.

The southern region of Benin faces recurrent floods every year, and the commune of Grand-Popo is no exception, significantly affecting farmers and pastoralists. These floods typically occur between September and November, during the minor rainy season, resulting in the complete loss of crops in most agricultural fields, except for vegetable farms located along the coast. Our surveys reveal that over 80% of farmers in the commune suffer crop losses.

For pastoralists, floods represent the worst time of the year. Among the interviewed pastoralists, almost all report sudden animal mortality, especially calves and lactating cows, animals under three years old, and old females due to their vulnerability to these conditions (see Plate three). During the flood period, nearly all herds from the Adjaha, Djanglanmey, Sazué, and Grand-Popo districts move towards the Gbéhoué district, accounting for 85%, while the remaining 15% head towards the Comé commune for refuge.

Fig. 5. Calves damaged by the flood (A) and an old female damaged by the flood in Gbéhoué (B)

Photograph taken by Soumanou, January 2023

Upon observing Plate 1, the damage caused by the flood to the cattle is evident. In Figure 5-A, two emaciated calves are visible, unable to keep up with the herd to the pastures due to the flood damage. Their owner is compelled to provide them with food at home. As for Figure 5-B, it depicts an old female, hungry and afflicted by a disease contracted from contact with other cattle in the same grazing area.

3.9 DISCUSSION

Les pratiques agropastorales sont essentielles pour la subsistance de nombreuses communautés rurales à travers le monde. Cependant, ces pratiques sont de plus en plus confrontées à des défis majeurs posés par le changement climatique. Ce phénomène global affecte à la fois les systèmes agricoles et pastoraux, entraînant des répercussions négatives sur la production alimentaire, les moyens de subsistance et la sécurité économique des populations dépendantes de ces systèmes.

Le changement climatique se manifeste par une augmentation de la variabilité climatique et la fréquence des événements extrêmes tels que les sécheresses, les inondations et les vagues de chaleur. Ces phénomènes altèrent la disponibilité des ressources en eau, un facteur crucial pour les pratiques agropastorales (IPCC, 2021). Les sécheresses prolongées, par exemple, réduisent la disponibilité des pâturages et des ressources hydriques, compromettant ainsi la productivité des animaux et des cultures. Des études montrent que les communautés pastorales en Afrique de l'Est ont subi des pertes importantes de bétail en raison de sécheresses récurrentes, affectant directement leur sécurité alimentaire et leurs revenus (Herrero et Thornton, 2013).

De plus, le changement climatique exacerbe la dégradation des terres et des ressources naturelles, déjà fragilisées par des pratiques agricoles intensives et non durables. L'érosion des sols, la salinisation et la désertification sont des problèmes croissants qui diminuent la fertilité des terres agricoles et la qualité des pâturages (FAO, 2017). Cette dégradation limite la

capacité des communautés agropastorales à maintenir et à augmenter leur production, les rendant plus vulnérables aux chocs climatiques. Il faut noter que l'élaboration de politiques appropriées et le soutien institutionnel sont indispensables pour aider les communautés agropastorales à faire face aux défis du changement climatique. Les gouvernements et les organisations internationales doivent fournir des ressources et des infrastructures nécessaires pour faciliter l'adoption de pratiques résilientes. Par exemple, les programmes de microfinance peuvent offrir un accès au crédit pour les investissements dans des technologies agricoles durables (Bryan et al., 2013).

4 CONCLUSION

In Southern Benin, particularly in the commune of Grand-Popo, research on agropastoral activities and the challenges they face has sparked considerable interest. The agricultural sector their grapples with significant difficulties, especially in the agropastoral domain. These problems stem from demographic pressure and the limited capacity of the land to meet the needs for livestock fodder and arable land.

Agropastoralism in Southern Benin exhibits distinct characteristics compared to the northern regions of the country. Unlike other areas, livestock feed is not a major issue in Grand-Popo, thanks to the availability of fodder throughout the year and the proximity to water sources. However, despite being widespread in the commune, this practice is not without its challenges.

Through this research, it has been observed that agro-pastoralists in Grand-Popo face multiple constraints, including animal health issues, conflicts related to land management, overgrazing, agricultural practices, droughts, and floods. These challenges significantly impact the management of herds and agricultural lands, sometimes making it difficult to reconcile the two.

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